

## GPS technology may enhance atmosphere monitoring

By Alan Buis

Artist's rendering of global positioning system satellite.



Dr. Thomas Yunck

### the eARTH

*A new, cost-effective technology based on the venerable global positioning system (GPS) may soon revolutionize the way Earth's atmosphere is monitored.*

Scientists at JPL are excited by early analysis of data from their prototype instruments aboard two international scientific spacecraft in low Earth orbit. Blackjack GPS receivers aboard the German Challenging Mini-satellite Payload, or "Champ," and the Argentine Satellite de Aplicaciones Cientificas-C (Scientific Applications Satellite), fitted with special antennas that focus on Earth's horizon, are tracking the radio signals broadcast by each of the 28 high-orbiting global positioning system satellites as they rise and set on Earth's

horizon. The process is called GPS limb sounding (also known as GPS occultation).

By measuring—to within a few trillionths of a second—the subtle changes in the time it takes for the GPS signals to arrive at the spacecraft as they travel through Earth's atmosphere, scientists can derive a surprising amount of data. These data include extremely precise profiles of atmospheric density, pressure, temperature and moisture content. Additional analysis can yield global pressure contour maps, critical climate variables and even the stratospheric wind fields that affect airline routes.

Preliminary evaluations indicate this technology will be applicable to fields as diverse as weather prediction and climate research, Sun-Earth interaction research, solid Earth dynamics and oceanography. It may also be used to create the first 3-D images of Earth's ionosphere, a turbulent and mysterious shroud of charged particles that, when stimulated by solar flares, can disrupt communications around the world.

"GPS occultation is a novel, cost-effective technology that augments current methods of Earth remote sensing from space," said Dr. Thomas Yunck, manager of JPL's GPS Observatories Office. "It offers accuracies and resolutions that rival those of instruments aboard weather balloons, while filling in large global coverage gaps. Such precise measurements of the lower atmosphere have never before been accomplished from space. Our prototype instruments are serving as vital develop-

mental test beds for GPS remote sensing. NASA looks forward to a blossoming of this remote sensing research as we continue to refine our knowledge of this new data source."

Tens of thousands of occultation soundings have already been made. Dozens of scientists worldwide are investigating how to best apply the data to Earth research.

GPS limb sounding offers numerous attractions. It can probe Earth's atmosphere from the top of the stratosphere (50 kilometers, or 31 miles up) directly to the Earth's surface. It can operate in all weather conditions. It can calibrate itself, resulting in stable measurements that can be compared between all occultation sensors over time. Its fully independent measurement of pressure and height permits atmospheric wind fields to be derived without external calibration or reference. In addition, it has numerous applications outside of atmospheric science.

The technology's biggest advantage may well be its low cost. GPS receivers, comparable in size and complexity to a notebook computer, can be built for a fraction of the cost of traditional spaceborne sensors and placed unobtrusively on many low-orbiting spacecraft. Since most Earth satellites already carry such devices for timing and navigation, upgrading those instruments for science purposes might possibly ignite a revolution in Earth remote sensing.

Yunck says the potential from even a small array of such instruments is impressive. A single GPS receiver in low orbit could acquire more than 500 soundings a day, spread uniformly across the globe—comparable to the number of weather balloons launched worldwide every 12 hours. When combined with Russia's 24-satellite GPS-like Global Navigation Satellite System and Europe's planned 32-satellite GPS-like Galileo system, a single GPS sensor could conceivably collect more than 2,000 soundings a day.

GPS limb sounding data from the Argentine Scientific Applications Satellite and Champ are available through JPL's GPS Environmental and Earth Science Information System at <http://genesis.jpl.nasa.gov>. The database is one of a new generation of data systems created under NASA's Earth Science Information Partners program, which seeks to create government-industry partnerships to advance Earth science. Additional information on this program is available at <http://www.esipfed.org>.

## Free lunch for staff on June 6

All personnel contribute to the overall success of the Laboratory. In celebration of a job well done, a free

lunch will be served to all JPL badge holders on the mall or on the Café 303 patio on Thursday, June 6, from 11:30 a.m. to 1 p.m.

Enjoy your choice of chicken, beef or vegetarian kabob, served with a seasonal fresh fruit salad, barbecue potato chips, cheesecake and assorted soft drinks or bottled water. Live music will be featured on the mall only. A JPL badge must be worn to participate.

In support of the thank-you celebration, JPL Café schedules for June 6 will be modified. 190 Crater Café will be open from 6:30 to 9 a.m. Grill service will not be available after 8 a.m., and 190 will be closed for lunch and afternoon break. The 303 Orbit Café will be open 6:30 a.m. to 3:30 p.m., with no grill service after 9 a.m. The lunch menu is limited to hot entrees, pizza, salad bar and Grab 'n Go. The 167 Red Planet Café will be open 6:30 a.m. to 3:30 p.m., with no grill service after 9:30 a.m. The lunch menu is limited to hot entrees, salad bar, and demo station.



## JPLer resolves orbits for newly found Jupiter moons

By Guy Webster

The discovery of 11 small moons orbiting Jupiter leapfrogs the number of that planet's moons to 39, nine more than the record of the previous champ, Saturn.

A team led by astronomers from the University of Hawaii made the discovery based on images taken in December 2001 and later follow-up observations. Orbits were determined by collaborators at JPL and the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.

Researchers estimate the new-found natural satellites are each about two to four kilometers (one to two miles) in diameter, and were probably passing rocks captured by Jupiter's gravity long ago.

The discovery-team leaders, Scott Sheppard and Dr. David Jewitt of the University of Hawaii, also discovered 11 other small satellites of Jupiter in 2000.

The new moons were discovered by Sheppard, Jewitt and Jan Kleyna of Cambridge University, England. They used the Canada-France-Hawaii 3.6-meter (142-inch) telescope with one of the largest digital imaging cameras in the world to obtain sensitive images of a wide area around Jupiter.

The digital images were processed and searched using computers. Candidate satellites were monitored in the succeeding months at the University of Hawaii's 2.2-meter (88-inch) telescope to confirm their orbits and to reject asteroids masquerading as satellites.

JPL's Dr. Robert Jacobson and Harvard-Smithsonian's Dr. Brian Marsden determined the satellites' irregular—highly elongated and tilted—orbits. All 11 objects orbit in the direction opposite to the rotation of the planet.

The orbits of the irregular satellites strongly suggest an origin by capture. Since no efficient contemporary capture mechanisms are known, it is likely that the irregular satellites were acquired when Jupiter was young, possibly still in the process of condensing down to its equilibrium size. As yet, nothing is known about their surface properties, compositions or densities, but they are presumed to be rocky objects like the asteroids.

The new discoveries bring the known total of Jovian satellites to 39, of which 31 are irregulars. The eight regular satellites include four large moons discovered by the astronomer Galileo Galilei and four smaller moons on circular orbits closer to Jupiter. Jupiter's nearest rival for having the largest number of known satellites is Saturn, with 30, of which 13 are irregular.

The satellites were formally announced by the International Astronomical Union on Circular No. 7900 (May 16, 2002). More information about them is available online from the University of Hawaii at <http://www.ifa.hawaii.edu/~sheppard/satellites/jup.html>. Other information about the Jupiter system is available from JPL at [http://www.jpl.nasa.gov/solar\\_system/planets/jupiter\\_index.html](http://www.jpl.nasa.gov/solar_system/planets/jupiter_index.html).



News Briefs

Cassini still going strong

JPL's Cassini spacecraft continues to fly in good health, speeding toward a July 1, 2004, appointment to begin orbiting Saturn.

Test images of a star taken in early May provide strong encouragement that a haze problem noticed on a Cassini camera lens is clearing up as anticipated, said Cassini-Huygens Program Manager ROBERT MITCHELL.

A 60-day period of warming the spacecraft's narrow-angle camera to a temperature just above freezing ended May 1. Heaters were built into the camera in anticipation of potential lens hazing; warming treatments have corrected similar hazing on other spacecraft.

Cassini's narrow-angle camera performed flawlessly for the spacecraft's December 2000 flyby of Jupiter. The haze first appeared last year, during the cruise between Jupiter and Saturn. Warming the camera to 4 degrees C (39 degrees F) for eight days ending in January 2002 produced improvements, so the same heating was repeated for 60 days. Another warming treatment, to last 26 days, began May 9.

Planet Finder studies chosen

As part of its quest to find Earth-sized planets around stars and look for telltale chemical signatures of life, NASA has chosen two mission architecture concepts for further study and technology development.

The two architectures are being explored for the JPL-managed Terrestrial Planet Finder mission, which is part of NASA's Origins Program, also managed by the Lab. Each concept would use a different means to achieve the same goal—to block the light from a parent star in order to see its much smaller, dimmer planets.

The Infrared Interferometer, using multiple small telescopes on a fixed structure or on separated spacecraft flying in precision formation, would simulate a much larger, very powerful telescope and would reduce the starlight by a factor of 1 million. The Visible Light Coronagraph, a large optical telescope with a mirror three to four times bigger and at least 10 times more precise than the Hubble Space

Telescope, would collect starlight and the very dim reflected light from planets. The telescope would have special optics to reduce the starlight by a factor of 1 billion, thus enabling astronomers to detect the faint planets.

The two candidates were selected based on results from four industrial-academic teams that conducted a 2-1/2 year study of more than 60 possible designs. The two architectures were determined to be sufficiently realistic to warrant further study and technological development in support of a launch of Terrestrial Planet Finder by the middle of the next decade.

Aerogel gets Guinness record

A new version of aerogel, the particle-collecting substance on JPL's Stardust spacecraft, has been recognized by Guinness World Records as the solid with the lowest density.

JPL's DR. STEVEN JONES, a materials scientist who helped create the aerogel used by Stardust, has created a lighter version that weighs only 3 milligrams per cubic centimeter (.00011 pounds per cubic inch.)

Guinness World Records approved the new aerogel's application for the least dense solid in March. Jones' aerogel beat out the previous record holder, an aerogel that weighed 5 milligrams per cubic centimeter.

Aerogel is pure silicon dioxide and sand, just as is glass, but aerogel is 1,000 times less dense than glass because it is 99.8 percent air.

Use of JPL password to expand

Within the next few weeks approximately 3,000 DocuShare users will be notified by library managers or librarians when access to electronic libraries converts to the new multi-purpose JPL Password. Further implementation of the JPL Password will occur in the months ahead in order to reduce the number of unique passwords that JPL personnel are required to maintain.

For more information about the JPL Password, see <http://eis.jpl.nasa.gov/dir/jpldir/password.html>. An overview of all frequently used Lab passwords is provided at <http://icis.jpl.nasa.gov/passwordmatrix.html>.

At that time, the quasi-optical transmission line—which provides signal relaying and duplexing—will be integrated with the antenna.

CloudSat Deputy Principal Investigator Deborah Vane said integration and tests of all subsystems are scheduled for next year.

CloudSat will provide the first continuous global orbital survey of cloud structure and physical properties. The data gathered will improve the models used to describe clouds in global climate and weather prediction models.

Since clouds are a basic part of the link between energy and water cycles present in the Earth's atmosphere, understanding their physical characteristics and associated seasonal and geographical variations is fundamental to meteorology.

CloudSat's 94 GHz cloud-profiling radar is expected to be several orders of magnitude more sensitive than available weather radars and will yield detailed observations of the water droplets and ice crystals in clouds. Unlike the recent DC-8 Airborne Cloud Radar aircraft experiment, CloudSat's continuous data will allow the seasonal and geographical variations of clouds to be captured.

The absorption present when looking through precipitation from the ground severely limits the radar sensitivity, thus the advantage to remotely sense the clouds from above.

CloudSat is a partnership between JPL, Colorado State University, the Canadian Space Agency, the U.S. Air Force, and the U.S. Department of Energy. Ball Aerospace is building the spacecraft. The antenna was built by Composite Optics of San Diego.

For more information, log on to <http://cloudsat.atmos.colostate.edu>.

Special Events Calendar

Ongoing Support Groups

Alcoholics Anonymous—Meetings are available. Call the Employee Assistance Program at ext. 4-3680 for time and location.

Codependents Anonymous—Meets at noon every Wednesday. Call Occupational Health Services at ext. 4-3319.

Gay, Lesbian and Bisexual Group—Meets the first and third Fridays of the month at noon in Building 111-117. Call the Employee Assistance Program at ext. 4-3680 or Randy Herrera at ext. 3-0664.

Caregivers Support Group—Meets the first Thursday of the month at noon in Building 167-111 (The Wellness Place). Call the Employee Assistance Program at ext. 4-3680.

Working Parents Support Group—Meets the third Thursday of the month at noon in Building 167-111 (The Wellness Place). For more information, call the Employee Assistance Program at ext. 4-3680.

Saturday, May 25

The Race for Our Future—Building Bridges, a Caltech community service organization, is sponsoring this fundraiser for college scholarships that will support two promising students at Blair High School. Races vary in length from 100 to 5,000 meters and will be held, rain or shine, at the Caltech track and North Field. To participate and/or make a donation to the scholarship fund, visit <http://bbridges.caltech.edu/race.html> and send the appropriate form to the address posted. Call (626) 676-1666.

Wednesday, May 29

"Modeling Relationships Using Graph State Variables"—A key architectural theme of the Mission Data System is explicit modeling of states. Certain essential states are relative, since they are defined in terms of reference points rather than absolute quantities. In this noon presentation in conference room 167, Matthew Bennett of Section 341 will describe graph state variables and show example representations for relative states such as spacecraft orientation, location, trajectories, dynamics and kinematics.

Thursday, May 30

Asian Pacific American Heritage Month Talk—Dr. Min Zhou, professor of sociology and chair of the Asian American Studies Inter-departmental Degree Program at UCLA, will present "Asian Americans Today: Demography, Diversity, Contributions, and Challenges" at noon in conference room 167. The talk is presented by JPL's Asian American Council. For more information, visit <http://www.ss-cnet.ucla.edu/soc/faculty/zhou>.



JPL Golf Club—Meeting at noon in Building 306-302.

Saturday, June 1

"California Liver Run/Walk 2002"—Participants and sponsors are sought for this event that seeks to raise dollars to help find a cure for hepatitis and other liver diseases. The 10K run and 5K walk will be held at Griffith Park in Los Angeles. Call Holli Leonard, ext. 4-5589 or (626) 355-1765. For more information, visit <http://www.liver411.com>.

Tuesday, June 4

JPL Gamers Club—Meeting at noon in Building 301-227.

JPL Genealogy Club—Meeting at noon in Building 301-271.

Wednesday, June 5

Associated Retirees of JPL/Caltech—Meeting at 10 a.m. at the Caltech Credit Union, 528 Foothill Blvd., La Cañada.

Thursday, June 6

JPL Gun Club—Meeting at noon in Building 183-328.

Saturday, June 8

Folk Music—Singer/songwriter Katy Moffatt will appear in Caltech's Dabney Lounge at 8 p.m. Tickets are \$12 for adults and \$4 for children under 12. Call (626) 395-4652 or visit <http://www.cco.caltech.edu/~folkmusi>.

CloudSat climbs to mesa for tests

JPL engineers earlier this month conducted successful tests on the CloudSat antenna. CloudSat is an experimental satellite that will use radar to measure the vertical structure of clouds and cloud properties from space. Launch is planned for April 2004 from Vandenberg Air Force Base.



Photo courtesy of Suzanne Spitz

Andy Rose (left) oversees unloading of the CloudSat antenna on JPL's mesa, where it underwent testing. Looking on are Greg Jones and Suzanne Spitz.

The preliminary tests, conducted on JPL's mesa antenna range area, confirmed that the three-mirrored antenna's far-field range was working properly, according to cognizant engineer Suzanne Spitz. The instrument was then moved indoors for further testing in the near-field chamber. When this portion of the testing is completed, by early June, the antenna will be transferred to the Spacecraft Assembly Facility for integration onto a support structure.

Service awards

The following JPL 2002 Second Quarter Service Award Recipients celebrating 20 or more years of service were invited to attend a luncheon and ceremony in their honor on June 5.

45 years: Hershal Fitzgugh.

40 years: Charles

Bryant, Edgar Davis, Richard Emerson, Robert Hall, Alan Hoffman, Ronald Howe, James Johnson Jr., Clayton LaBaw, Frank Leppla, Warren L. Martin, Kenneth Peralta, Robert Polansky, Raymond Prizgintas, Thomas Shain, Jimmie Tomey, Alvin Willems.

35 years: Stanley Butman, George Danielson Jr., Joe Foster, Arthur Franzon, H. Kent Frewing, William Hurd, Patricia McLane, John Meysenburg.

30 years: Richard Cardenas, James Fuhrman, Ingrid Hsu, Susan Linick, Robert Miller, Jose Miranda, Allison Owens, Ted Peng, George Rinker, Gary Yagi.

25 years: Frederick Akers, Charles

Avis, Julian Blois, Barbara Bonzo, Larry Bright, Robert Cesarone, Charles Cruzan, Kirk Gerbracht, Ronald Hellings, Jose Landeros, Linda Lee, Thomas Logan, Albert Magallanes, Lee Mellinger, Donald Rockey, Yvonne Samuel, Chester Sasaki, Donald Sevilla, Barbara

Sherrod, Jeffrey H. Smith, Jan DM Smith, Clara Sneed, Gerald

Snyder, Thomas Starbird, Curtis Tucker Jr., Joseph Wackley, Yvonne Zieger.

20 years: Donna Bonorris, Natividad Chavira, David Childs, Paul Chodas, Deirdre Darrow, Robin Dumas, Randall Foehner, Ivan Gall, Dwight Geer, Gail Linehan, Kathleen Lynn, Leon Maldonado Jr., Scott Markham, Thomas Meehan, Sandra Menotti, Barbara Mochrie, Steven Moniz, William Neiderheiser, William Poirier, Christopher Porter, Paul Rapacz, Audrey Ridley, Mary Romejko, James Rooney, James Shmitka, Krishna Sinha.

For information on JPL's Employee Services & Recognition Program, log on to <http://cis/sec614/reward>.





# DC Honors JPL's 40th



## JPL'S CELEBRATION

of the 40th anniversary of the first U.S. planetary mission, Mariner 2, and the 25th anniversaries of Voyagers 1 and 2,

made its way to Washington, D.C. on

May 7 with "Journey to the Planets and Beyond," an event held at the Smithsonian Institution's National Air and Space Museum. In attendance were Lab Director Dr. Charles Elachi and all surviving former directors, as well as other JPL and NASA officials, members of Congress and special guests.

The celebration included a new video produced by the Office of



Astrophysics Program, Mission and Systems Architecture Section, set up a display. Elachi, at center, introduces participants in a panel discussion; from left are Tom Young, mission director of the 1976 Viking landings on Mars and former director of NASA's Goddard Space Flight Center; Pickering; Murray; and Stone. Dr. Ed Weiler, NASA's associate administrator for space science, greets U.S. Rep Adam



Communications and Education on JPL's history and current missions. A videotape of the Smithsonian event is being prepared for archiving on the Daily Planet, JPL's online news source (<http://dailyplanet>).

Clockwise from top: Viewing a 2003 Mars Exploration Rover model are Shaun Parkin (left), aide to Utah Senator Bob Bennett, and Kevin Burke, an engineer from JPL's Mars Exploration Rover Project. From left: former JPL Directors Dr. William Pickering (director from 1954-76), Dr. Edward Stone (1991-2001), Dr. Lew Allen (1982-90), Dr. Bruce Murray (1976-82) and Elachi.



Schiff (D-Pasadena). From left: NASA Administrator Sean O'Keefe, U.S. Rep. David Drier (R-San Dimas), and Caltech President Dr. David Baltimore. Karen Yuen (left), Earth outreach theme lead, and Dr. Andrea Donnellan, deputy manager, Earth and Space Sciences Division, chat with O'Keefe.



Photos by Bill Ingalls / NASA



# 40 years later, a Dodger game just for JPL, campus

Right: Dodger Stadium on Opening Day, 1962.

DailyPlanet

Online for the JPL community

Classified ads will be available the day before Universe is published, at <http://dailyplanet>

JPL's online news source

View this and previous issues of Universe online <http://universe.jpl.nasa.gov>

Editor

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Universe is published every other Friday by the Office of Communications and Education of the Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109.

Notice to Advertisers

Advertising is available for JPL and Caltech employees, contractors and retirees and their families. No more than two ads of up to 60 words each will be published for each advertiser. Items may be combined within one submission. Ads must be submitted on ad cards, available at the ERC and the Universe office, Bldg. 186-118, or via e-mail to [universe@jpl.nasa.gov](mailto:universe@jpl.nasa.gov). Ads are due at 2 p.m. on the Monday after publication for the following issue.

All housing and vehicle advertisements require that the qualifying person(s) placing the ad be listed as an owner on the ownership documents.

Just as JPL is celebrating the 40th anniversary of planetary exploration this year, another Southern California institution is also celebrating its 40th—Dodger Stadium. Four years after moving to Los Angeles from Brooklyn, N.Y., the Dodgers opened their new home, still considered one of the best ballparks in the major leagues. Today, the Dodgers are offering JPL and Caltech staff a special deal. Tickets are still available at the JPL Store and the Caltech Credit Union in La Cañada for the Dodgers' Saturday, June 1 matchup against the world champion Arizona Diamondbacks. Tickets are \$10 for Lab and campus employees, with pregame activities including a carnival (face painting, clowns, games, and much more) starting at 11 a.m. Game time is 1:10 p.m. Bus transportation to the game from Caltech is also available for \$3 per person. For more information, log on to the JPL Store website at <http://www.jplstore.caltech.edu/dodgers.html>.



## Passings

**WILLIAM TIEDGE**, 77, retired manager of Space Flight Operations Facility operations and engineering support, Section 663, died of cancer April 29. Tiedge worked at the Lab from 1956–79. He is survived by his wife, Mary; sons Brian and Jeffrey; and three grandchildren. Services were private.

**CLARENCE TUTTLE**, 85, a retired engineering test associate in Section 345, died of Alzheimer's disease May 9. Tuttle joined JPL in 1950 and retired in 1982. He is survived by daughters Signe, Eileen and Cathy; six grandchildren and two great grandchildren. Services were held May 15 at Eternal Valley in Newhall.

## Retirees

The following JPL employees retired in May: Theodore Pavlovitch, 38 years, Section 381; Richard Haga, 33 years, Section 341; Douglas Griffith, 28 years, Section 920; Dennis McCreary, 28 years, Section 341; Chaw-Kwei Hung, 27 years, Section 369; Eugene Vosicky, 13 years, Section 185.

## Letters

I would like to thank all those who worked with my husband, Ed Christensen, who passed away March 19. I received so many beautiful flowers and comforting cards of condolence from everyone who worked with Edward (Chris) in the past and present. Chris enjoyed his years at JPL and felt especially proud to have worked with so many talented and caring people. Along with others at JPL, he was there for milestones in space and also worked in Houston when man walked on the moon. His years at JPL were not wasted, for it was where he wanted to be. Thank you for making his journey so worthwhile.

I was so comforted to see all those who attended the funeral; and I know that he was touched to see how much you all cared, because he truly cared for you. And thank you to those who could not make the funeral but called and sent beautiful messages. I enjoyed hearing your stories of Chris and hearing how much you cared. God bless you all. I remember you in my prayers.

Jan Christensen

We would like to thank the JPL community for its supportive response during our Mother's recent illness and passing. It makes a big difference. We appreciated all your kind thoughts and help.

Mike and Stan Sander

My wife and I extend our thanks to all at the Lab for the beautiful plant sent to our home at our time of grief. After a long illness, my wife's mother passed away on April 2. Thank you again for thinking of us in this time of need.

Kirk and Mary Bonner

I would like to thank my friends and co-workers for their support following the recent passing of my father. Your kind thoughts and words have been a great help during this time of mourning. Thanks to JPL for the plant.

John V. Sisino

## Classifieds

### For Sale

BABY ITEMS: front carrier, Evenflo, soft, \$7; car seat w/base, Century, rear-facing, \$40; bathtub carousel, Safety1st, \$7, all in superb cond., prices are obo. 626/791-6101.

BAKERS RACK, with wine rack/chop block, exc. cond., never used, \$100. 798-8071.

BED, antique oak & rod iron, queen sz. w/rails, \$150/obo, see picture @ERC). 626/744-9064.

CAMERA, Mamiya M645 SLR, A & E prism, 220 back, w/120 & 220 roll film holders and inserts, deluxe power motor dr. lenses, 45 mm, 80 mm & 105-210 zoom, Sunpak auto flash, mod. 555, alum. case, \$2,200. 323/257-7668.

CARPET, beige/light brown, exc. nylon, new, never used, \$300; HEADBOARD, queen size, blue vinyl, \$50. 798-8071.

CART, by Huge Cart, folds flat, brand new, \$35/obo. 626/791-6101.

CARTRIDGE DRIVE, Syquest, 44MB, \$15; CARTRIDGES, Syquest 44 MB, \$1 apiece; 50 CD JEWEL cases, \$10; DIET TAPES, Jenny Craig, set of 14, \$50; COMPUTER POWER CONTROL CENTER, 5 power switches + 1 master switch, 5 surge-protected outlets + 2 modem/fax/phone jacks, new, \$20; ORGAN, Yamaha 415 electronic console w/13 pedals, 3 keyboards, 144 rhythm patterns, pd. \$7,500, sacrifice for \$3,000. 790-3899.

CHINA CABINET, 1950s Drexel mahogany, email for photo, lelson@bigfoot.com, \$500, cash and carry. 353-9367.

CHIPPER-SHREDDER, Mantis, yard waste shredder, 5 HP Honda motor, handles 2" branches, \$100. 626/564-1384.

COOKBOOKS: Good Housekeeping 1965 Encyc. of Cooking, 3-vol. boxed set, \$15; Better Homes & Gardens Encyc. of Cooking, 20 vols., \$40; Microwave Cooking Library, 14 vols., \$40; MAGAZINES, African Violet, 40 issues, misc. years 1957-75, \$30. 626/357-0209.

COFFEE TABLE, light pine, glass top, carved legs, 49 x 28, 3 mo. old, exc. cond., \$150. 249-0573.

EXERCISE EQUIPMENT, NordicTrak, perfect cond., all black metal and wood, 'no frills' model, perfect for woman or lightweight man, \$150/obo. laurel@ekit.com.

FREON 22, unused, unopened 30 lb bottle, 3 blocks from JPL. \$60/obo. 352-7892.

FURNITURE: Ethan Allen loveseat, blue velvet, \$45; Henredon sofa, 80," white w/pastel wildflowers & loveseat; \$400; storage chest, low 78," 4-door, on wheels, \$45; coffee table, mahogany, \$50, coffee table w/drawer, 52"x32," \$50; sofa-bed, white tweed, full-size, \$100. 626/357-0209.

GARAGE DOOR OPENER, Stanley, 8-foot rail, chain drive, exc. cond., 2 new transmitters, \$85. 909/596-8117.

GUITAR, acoustic, 00016 Martin, solid spruce top, rosewood inlaid fingerboard, scale 25.4", bracing hand carved, rarely played, immac., hardshell case, orig. owner/papers, \$900/obo. laurel@ekit.com.

HOT TUB, seats 4-5, 2 years old but hardly used, came with house; gas heater, cover and supplies; must pick up, originally \$2,700, sell for \$950/obo. 626/798-6488, Gordy.

MOVING SALE: Treadmill, Pro. Form 365 SI, folds against wall, like new, \$200; Typewriter, IBM Selectric, needs cleaning, \$25; 2 lg. end tables, gold leaf top, \$20/ea; 2 headboards, twin, \$10/ea; rocking chair, blue velvet, \$25; chair, orange velvet accent, \$25; TV, 13", color, w/remote, \$50. 353-3836.

PIANO, Chicago upright, Weiser & Son, \$400/obo. 353-2772, after 5 p.m.

SKI SET, used women's Head 170s, Gala Radial & poles; Salomon boots, sz. 7 & bindings, see picture @ ERC, \$150/obo). 626/744-9064.

SOFALOVESEAT, brown, exc. cond., \$200/both; SWIVEL CHAIR, matching, \$50; TABLE, dining room, with leaf, cherry wood tops, black legs, 4 chairs, good cond., \$150; SOFA/SLEEPER, makes into queen size bed, abstract black, blue and mauve design, good cond., \$300; BICYCLES, children's, 4, \$15/ea. 626/357-8210.

TABLES, coffee + 2 end, oak with beveled glass inset, \$100/all. 661/254-7443.

TICKETS, Dodgers, various games throughout the season, 2 seats on loge (orange) level near first base, \$23 per ticket. 626/296-1253.

YARD SALE, 2100 block of Galbreth Rd., betw. Craig & Allen, Sat.-Sun., June 1-2, 8 a.m.-3 p.m.: treasures, '50s collectibles, toys, kitchen items, children's/men's/women's clothes, desk, computer tables, glassware; items too numerous to mention.

### Vehicles/Accessories

dr., a/c, pwr. steering/ABS brakes/window/door-locks, dual airbags, cruise contr., metallic silver, super clean, Michelin tires, \$4,995. 626/798-1765.

'96 FORD Escort LX, 2 dr. hatchback, stick shift, A/C, stereo, only 60K mi. \$4,650. 909/985-6806.

'94 FORD T-Bird, red, auto, pwr. steering/brakes/doors/windows/seat, tilt wheel, cruise control, am/fm/cassette, new tires, alarm w/keyless entry, one owner, all maint. records, 125K mi., exc. cond. inside and out, \$3,900. 909/596-8117.

'87 FORD F150, black, V8, 5.0, A/C, power doors/windows/brakes, auto, cruise control, 1/4 cab & bedliner, towball, wiring, HD springs, good cond., \$2,900. 951-3653.

'01 HONDA Accord EX, silver, gray int., auto, orig. owner, all options, tinted glass, 31,000 mi., \$18,450/obo. 909/468-9966.

'98 HONDA Civic LX sedan, 4 dr., white w/gray cloth interior, 46K mi., automatic, pwr. brakes/door locks, AM/FM stereo, a/c, tilt steering, cruise control, tinted glass, driver and passenger side airbag, deluxe wheel covers, rear defroster, 1 owner, great cond., \$11,400/obo. 956-8060.

'92 HONDA Accord EX sedan, 4 dr., 106K mi., gd. cond., white w/blue int., auto., 4 cyl. 2.2 ltr., front whl dr., a/c, p/s, p/w, p/dl, cruise cont., ABS, tilt whl., sun/moon roof, am/fm anti-theft stereo/cassette, gd. tires, \$5,500. 626/296-9073.

'81 HONDA Interstate SilverWing, shaft drive, water cooled, Prolink suspension, just over 6,000 mi., garage kept, near mint, second seat for passenger, see <http://home.attbi.com/~macmaven/sw/index.htm> for pictures . \$2,250. 353-2103.

'93 KAWASAKI Ninja 600R, 16K mi., exc. cond., clean, black with turquoise/purple stripe, black leather tank cover, see picture at JPL Store, \$3,600/obo. 501-8161.

72 MERCEDES 280 SE 4.5, tan, 4 dr., 4.5 liter V8, a/c, recent brake work, tires, battery, 87K mi., runs exc., needs cosmetics, minor work, \$3,500. 714/840-3688.

'97 TOYOTA Camry LE, good cond., automatic, a/c, power locks/windows, sunroof, premium wheels, white w/gold trim, 58,000 mi., \$10,500. 626/290-1970.

'96 TOYOTA Avalon XL sedan, 4 dr., 92K mi., exc. cond., golden color, auto 6 cyl., a/c, p/s, p/w, cruise cont., ABS, am/fm/stereo, gd. tires, new battery, 1 owner, \$10,200/obo. 909/865-1049.

'96 TOYOTA Corolla DX 4 dr., 57K mi., a/c, am/fm cassette, pwr. windows and door locks, exc. cond., \$7,950. 626/798-5835.

'88 TOYOTA Celica ST, runs great, clean, air, power, automatic, \$2,500/obo. 626/831-8868.

### Wanted

ANVIL & BLACKSMITH TOOLS. 626/798-6588.

CARPOOL PARTNER, part-time, to JPL fr. Laguna Niguel/Irvine area. 949/363-2418, Michael.

HOUSEKEEPER, part-time, light housekeeping and child care, weeknight evenings and weekends, La Canada. 790-1893.

HOUSING, for male JPL engineer starting mid-summer, non-smoker, quiet, commuting to visit family on weekends, neat, handy, musical, willing to do chores. futilitarian@attbi.com or 730-5807.

HOUSING, mid-June thru mid-Sept., nr. Caltech or in Glendale. 626/793-2271, alina@ieee.org.

SHOPPERS, "Shop Till You Drop" May 29, 5:30-8 p.m., Arcadia Elks Lodge, 27 W. Huntington Dr., free admission, latest spring/summer fashions from Nordstrom, Macy's, Robinson's-May and Bloomingdale's; 50-70% off store prices; sizes 4-24, girls dresses, handbags, scarves, jewelry; all proceeds donated to disabled children in CA and Hawaii. 626/447-2025.

SPACE INFO/memorabilia from U.S. & other countries, past & present. 790-8523, Marc Rayman.

SPONSORS for Avon Breast Cancer 3-Day walk, from Santa Barbara to Malibu in Oct.; see <http://www.brownwrap.pledgepage.com>, click on 'links.'

VOLLEYBALL PLAYERS, coed, no beginners please, every Tuesday night 8 to 10 at Eagle Rock High School, \$3/nt. 956-1744, Barbara.

### Lost & Found

FOUND, ladies sunglasses in case, in Bldg. 601 parking lot, also found at a different time, a gold tone cross. 4-9550, Barbara.

### Free

CAT, male, neutered, 3 yrs. old, gray stripes, shots current (Feb.), litter trained, lives with two females who do not treat him well, he is friendly and likes to be held. 626/914-1241.

DOG, Pongo, loving full-blooded black Labrador 7 months old, needs good home with big backyard, plenty of love and attention, great with kids, all shots, loves water. 626/290-6199.

### For Rent

ALTADENA mini-mansion, 4 bd., 2 ba. huge yd. w/ pool & jacz., basketball court, bar, patio, cent. heat & a/c, fireplace, stove, washer/dryer, security gates, Brinks, off-st. parking, close to JPL, gardener 2x month, \$1,950 +first and last, 790-1893.

ALTADENA, 3 bd. house, 1/2 mi. / JPL, new kitch. & bathroom, fenced shaded yd., water, trash pd., non-smokers, avail. July 1, \$1,400. 382-4751.

ALTADENA, 1 bd. guesthouse, fenced yard, secure, clean, quiet, Florecita area above E. lot, walk to JPL, avail. 6/1, \$495 + 1/3 util. + \$600 security dep. 626/794-6076.

GLENDALE house to share, unfurn. bd., share

ba., in roomy 2-bd. home, full house privileges, laundry, garage, yard, quiet neighb'hood, 15 min. from JPL, no pets, no smoking, female preferred, avail. June 1, \$625 + 1/2 utilities. 507-5632.

LA CANADA/FLINTRIDGE, room, 2 mi./JPL, priv. ba., kitch. privileges, pool, BBQ, parking, 790-1280.

LA CRESCENTA house, extra nice, 2 bd., 1 ba., fireplace, 5 min./JPL, cent. heat, formal din. rm., water and gardener inc., no smoking or pets, \$1,550. 805/659-1742.

MONROVIA/ARCADIA—area house, 2 bd., 1 ba., stove, refridg., washer/dryer hookups, front yard, covered patio, \$825, water/gardener/trash paid. 626/447-5725.

PASADENA, studio apt., with balcony, new paint and carpet, very private, 2 blks. from PCC, no pets, \$500 w/6-month lease. 590-2793.

PASADENA, spacious 2-story condo, 3 bd., 2.5 ba., prestigious community, beaut. inter., bright kitch., prof. landscape, ctrl. air & heat, close to shop/schls, cozy l/r with f/p, end unit, frml d/r, hdwd. flrs., immac. cond. \$1,750. 626/396-9024.

PASADENA condo, S. Oak Knoll, 1 bd., 1 1/2 ba., a/c, carpeting, laundry facilities, patio, refrigerator, stove etc., \$1,250, \$1,500 security deposit. 626/744-3243 or 626/791-3831.

PASADENA condo; large, covered balcony; 2 bd., 2 ba.; secure parking; central air & heat, nice quiet neighb'h'd; no pets; \$1,350. 626/826-9868.

PASADENA apt., 1 bd., 1 ba., new carpet/paint/ bathroom/kitchen, laundry facilities, unfurn., 2nd floor in a gated building, parking underneath, nr. Caltech & Lake, \$800. 626/577-9965, Carol or 626/786-2464, Wang; ask for Mrs. Li's apt.

PASADENA, townhome-style apt., furn., 2 bd., 1.5 ba., a/c, parking, patio, laundry facilities, no pets, co-ops welcome, \$1,195 + util. 626/351-9641.

PASADENA, furnished apartment to share, 2 bd., 1.5 ba., a/c, parking, patio, laundry facilities, no pets, \$595/mo. each, plus utilities. 626/351-9641.

### Real Estate

BARSTOW, small 2 bd., 1 ba., on 2 acres, nr. Calico Ghost Town, fenced w/lots of pine trees, very quiet, perfect weekend getaway home or frequent Goldstone assignments, \$49,500. 760/254-2379.

PASADENA/SIERRA MADRE, 8 mo. new, 3 bd., 2 ba., 2,300 sq. ft., architecturally designed contemporary home, open floor plan, 12' ceilings, walls of glass, emphasizes steel, glass, stone and wood, magnificent views from every room, 3 decks, gourmet kitchen, top of line S/S appliances, granite counters, hardwood, marble flooring, \$699,000. 626/345-9111.

SHOW LOW, Ariz., 3 bd. house, .43 acres w/ ponderosa pines, nat'l gas, sewer, in town subdivision, close to skiing and fishing, great investment property, house nds. help, \$30K/obo. Randall.Mielke@fjivillage.com.

SUN VALLEY/SHADOW HILLS, 10 mi./JPL, luxury townhouse, very nice gated complex, 3 bd., 2.5 ba., fully remodeled throughout, wood flooring, new kitch. cabinets, granite countertops, brand new appliances, recessed lights, new carpeting, custom drapes, beautiful, cozy and secluded backyard w/fruit trees, rose bushes & nice sitting area, beautiful mtn. view. 504-6256.

WILLIAMS, Ariz. area, (10 mi. away), 43 acres w/2-rm house, seasonal pond, wildlife everywhere, house on top of cliff w/great views, 4-mi. dirt road access year round, great investment, \$42K cash/obo. Randall.Mielke@fjivillage.com.

15 BICYCLE MINUTES/JPL, charming, colorful, sturdy, historic Spanish house; unique character, retiring artist's residence; 7,650 sq. ft. lot, 2,112 sq. ft. structure, 10 rooms, hardwood floors, tiled kitchen/all appliances included, tiled baths, beautiful antique fireplace, landscaped gardens, 20 trees, detached 2-car garage, very green, very private, gated, very well kept, many special features, move-in cond.; mid \$400Ks. 626/398-3332.

### Vacation Rentals

CAMBRIA, ocean front house, sleeps up to 4, exc. view. 248-8853.

HAWAII, Kona, ocean front on Keauhou Bay, house and guest house comfortably sleep 6, 3 bd., 2 ba., rustic, relaxing and beautiful, swimming, snorkeling, fishing, spectacular view, near restaurants, golf and other attractions. 626/584-9632.

HAWAII, Maui condo, NW coast, ocean front view, 25 ft. fr. surf, 1 bd. w/loft, compl. furn. phone, color TV, VCR, microwave, d/w, pool, priv. lanai, slps 4, laundry fac., 4/15-12/14 \$105/nite/2, 12/15-4/14 \$120/nite/2, \$15/nite/add'l person. 949-348-8047 or jackandrandy@cox.net.

MAMMOTH, Snowcreek, 2 bd., 2 ba., + loft, slps. 6-8, fully equi'p'd kitch. incl. microwave, D/W, cable TV, VCR, phone, balcony w/mtn. view., Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL disc. 626/798-9222 or 626/794-0455.

OCEANSIDE condo, fully furn., 2 bd., 2 ba., fireplace, full kitch; quiet, relaxing, beautiful beach-side setting; BBQ, pool, spa, game room; great ocean view, easy walk to pier and restaurants, sleeps 8; weekly or monthly. 909/981-7492 or dfhaugc@yahoo.com, Darlene.

PARIS: duplex apt. in stylish new bldg, short-term rental; slps 2, fully eq'p'd, beautifully furn.; centr. located yet completely quiet. 626/792-5942.

ROSARITO BEACH condo, 2 bd., 2 ba., ocean view, pool, tennis, short walk to beach on priv. rd., 18-hole golf course 6 mi. away, priv. secure parking. 626/794-3906.

VENTURA beach house, 3 bd., 1 ba.: 1 queen, 1 full and 2 twin beds; short walk to beach and Marina Park, \$125/nt. 248-0521.